

Tracking Low Flying Aerial Vehicles in a High Clutter Background

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Introduction. A serious potential threat exists from aircraft flying at **low altitude, very slowly, carrying airborne CBR agents**. This team has developed an innovative algorithmic approach to the detection and tracking of low flying aerial vehicles, which are capable of causing great damage the United States, a task that is a recognized priority of the Defense Department. The model A&M has developed represents a technology that can be inserted into existing programs, e.g. Aerostat or Hawkeye.

Statement of the Challenge. The low altitude flyers includes cruise missiles, unmanned aerial vehicles (UAVs), as well as other small hand fabricated aircraft. This technology, however, focuses specifically on the slow flyers, *which are more difficult to detect against a high clutter background* because they do not *present a significant moving target indication (MTI) signature* to a radar signal.

Rusty Freighter “*Rusty Freighter*” is a code designation for an attack against the continental United States, Europe or Israel where the airborne threat is launched from a tramp steamer obscured by fog or rain. It carries a commercially available Global Positioning System using a guidance and navigation package and a *chemical/ biological warhead*. Its purpose is terrorism. The scenario is highly feasible and can be accomplished by a small band of renegade terrorists.

There are three significant factors involved in the *Rusty Freighter* scenario. *First*, all the components are low technology, inexpensive and easily available *off the shelf*. *Second*, the aerial platform can easily be made stealthy and invisible, particularly in bad weather launch conditions. Its slow speed makes it look like an almost invisible stationary target against the background clutter so the Moving Target Indication (MTI) radar is less effective. When combined with a faster cruise missile threat the detection process is further compromised. *Third*, a large number of terrorist organizations and third world rogue nations with perceived grievances against the United States can find the motivation to exploit any weakness in the our force structure.

Drug Interdiction. Illicit drugs are still brought into the United States by low flying, radar avoiding light aircraft despite many ongoing programs for drug interdiction. These light aircraft have many of the characteristics of the UAVs in the *Rusty Freighter* scenario except that the aircraft are larger, fly faster, and are easier to detect. Moreover, the consequences of “leakage” i.e. allowing drug carrying aircraft to pass through undetected are much less severe.

Applicability of the Proposed Technology. This paper addresses both threat scenarios, directly. *It provides both algorithms and software that can be inserted into existing programs as product improvements to upgrade their capability. Building the simulation code is a trivial matter, once the algorithm suite has been built and tested.* The body of the paper describes the derivation of the formulae and mathematics of the problem to discern the flight properties of the targets, and, just as importantly, to filter the true target from the false echoes.